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Financialisation, Climate Finance, and the Calculative Challenges of Managing Environmental Change

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Abstract

This article describes the emergent and unstable dispositif of climate finance that is being built from iterative experiments in climate finance provision. The article provides a periodisation of different phases of climate finance from the 1990s onward using examples from REDD+, ecosystem services, the Green Climate Fund, green bonds, and insurance-based derivatives, and connects this periodisation to broader processes of financialisation. It analyses how climate finance projects incorporate competing systems of accounting denominated in carbon, natural capital, “green-ness”, insurance risk and internationally transferred mitigation outcomes. The article argues that many accounting units are evident in current climate finance products, each loosely derived from a different phase in this periodisation. However, experiments in calculating time and value in climate finance continue, and although risk is being increasingly used to correlate different denominators of value, an overall solution for how climate change is to be accounted for in financial interventions remains elusive.

Keywords

valuation, climate finance, financialisation, dispositif, climate change, risk and insurance

Introduction

By managing what gets measured, we can break the Tragedy of the Horizon. (Mark Carney, Governor of the Bank of England 2015)

Climate finance has taken an increasing role in climate change governance since the 1990s. This reflects and has been partly caused by processes of financialisation in the global

economy more broadly, which have placed finance more centrally in technologies of human governance. This paper contributes to the literature on this relationship between finance and the management of climate change within the context of financialisation, focussing on the period from the late 1990s, where present financial investments and returns are increasingly generated from a risk-based orientation to expectations of the future (cf. Johnson 2014). During this period, the role of finance in nature-society relations has expanded, which has been explored in human, economic and financial geography and related disciplines (Castree 2010; Christophers 2016; Mawdsley 2018; Robertson 2012). These literatures are now vast, and cover how nature and finance are increasingly entrained in projects and practices of conservation (Sullivan 2013a, 2013b); environment (Cooper 2010; Loftus and March 2015) and specific sectors such as weather management (Johnson 2014; Pryke 2007); infrastructure (Hildyard 2016), oil (Labban 2010 2014) or development interventions (Mawdsley 2018). There have also been important caveats as to whether the actual generation of revenue streams from financialised assets has been as great as financialisation theories have suggested. For example, Brockington and Duffy (2010) noted their remarkable absence in conservation (see also Dempsey 2017). The purpose here is to further apply the literature on financialisation, risk and value to a better understanding of climate finance.

This article will review climate finance and its constituent products and practices, how they are conceived and delivered and by whom, and how these have changed in relation to broad phases of financialisation. The second section reviews theories of financialisation in relation to climate finance instruments and markets and organises the history of climate finance into a loose typology to illustrate its reciprocal relationship to the global economy. The third section explores emergent institutional and organisational possibilities with attention to how hybrid products are created within several governance nodes. These multiple actors then both confound and build standardisations and commensurabilities in the calculation of value. The final section before the conclusion then uses examples of recent insurance-based products to explore how they correlate together different forms of calculation, including in respect to time.

The paper argues that the concept of risk, as a “technology of valuation” (Bracking et al. 2014) in climate finance, has become the central parameter in the valuation process, helping to frame, organise and compute a climate finance product with an assigned price.ⁱ Representations and imaginations of risk have been integral to capitalism for centuries, as it enables uncertainty to be rendered calculable (De Goede and Randalls 2009), and imposes “upon its subjects the technique of foreseeability” (O’Malley 2003: 278; see also O’Malley 2004). This more recently established salience of risk as an organising concept in climate finance has occurred both because of this accumulated technology, and also because risk can be used as a calculative common denominator within a matrix of other social and ecological

measured units, as is illustrated below. Risk has utility in broader valuation processes because it is recognisable and amenable to calculation for financiers who provide insurance and debt products in a way that social or ecological impacts, or indeed climate change, are not: risk benefits from being already central to the lexicon of finance capitalism.

The case studies presented here are representative of pioneer experiments in climate finance in which differing valuation norms and practices are jostling for dominance. There is an increasing use of risk and insurance in the delivery of climate finance found in these examples. However, the terrain remains experimental and there are huge challenges for financiers in applying risk and insurance valuation technologies to climate finance, not least in relation to who will generate demand for products and who will pay for them. To describe and begin to analyse how climate finance is emerging as a governance technology for managing climate change the article employs the Foucauldian concept of a *dispositif* as a type of assemblage that iteratively combines heterogeneous elements of living and non-living things in a manner which generates their pacification, framing and therefore the governance of components of the *dispositif* as revenue generating products (Legg 2011: 131; see Fredriksen 2015).

Phases in the Financialisation of Nature and Climate

The most common understanding of financialisation is where finance becomes increasingly dominant in the economy in relation to production, with financial activities generating more value over time in comparison to trade and commodity transactions (Arrighi 1994; Christophers 2012: 273-275; Krippner 2004: 14; Krippner 2005; Labban 2010: 545; Stockhammer 2004). While the empirical hypothesis of the increasing global scale and scope of financialisation has been questioned by Christophers (2012, 2015) as has its epistemological and ontological dimensions (Christophers 2015), it is possible to show empirically that at an aggregate scale, both a greater quantity of interest-bearing capital is produced over time, and a greater proportion of capital becomes interest-bearing (Bracking 2016: 20-41). However, these observations at macro scale do not explain how greater interest-bearing value is produced in relation to a particular commodity such as climate.

The financialisation process of nature-based assets, in which “climate” was more latterly added, can be dated from the debt-for-environment swaps of the 1980s, and occurs when a previously unpriced asset or service is entrained, or a notional one framed, and an income stream created from its existence in place, even if that place is virtual. These new products developed in roughly four periods, although these are not strictly linear: from the Kyoto Protocol and subsequent experiments in carbon accounting, carbon markets and certified emissions reductions (CERs) from the 1990s-2000s, with CERs hitting their highest prices in the mid-2000s (Phase I); to financialisation by ecosystem services, REDD+ forest

conservation and biodiversity offsets from the late 1990s (Phase II); interventions by capital markets proper, through green bonds, derivatives, indexes and synthetics from the 2000s onward (Phase III); to index insurance, risk-based multi-trigger products, and insurance-linked securities from 2010s onward, indicating a reinsurance regime of tradable derivatives (Phase IV). While crop insurance has a longer history, the Phase III-IV here can be isolated as recent in the sense that they are embedded in the more modern practise of modelling without any specific requirement to link payments to individual insurance clients. In all periods, financialised nature has been framed, abstracted and pacified as providing “services”, or even merely “experiences” or “mitigations”, free to circulate as liquid paper (Büscher 2013; Igoe 2013; Sullivan 2013a). These phases are important to isolate, not because they are mutually exclusive – as each merges and morphs into the next and borrows calculative technologies from former phases – but because each contributes components to the contemporary climate finance dispositif. These components can be narrative framings, organisational forms, valuation technologies or calculative devices – where a calculative device is understood as a procedure, spreadsheet, pro forma, equation, or evaluative practice (see Bracking et al. 2014). These combine both within individual products and in the overall, but constantly changing, climate finance dispositif.

Financialisation “Phase I” was intimately bound up with the commercialisation of carbon as a unit of account, and despite the rise and then spectacular fall of the European Emissions Trading System from 2005 to date, carbon remains central to the contemporary imaginary of the financialisation of climate. By 2018, there were 51 carbon pricing initiatives ongoing, including 25 emissions trading systems (ETs) and 26 carbon taxes covering about 20 percent of global greenhouse gas (GHG) emissions to a combined value of US\$82 billion (World Bank 2018: 10). Provision was made for an international carbon market in Article 6 of the Paris Agreement in 2015. We return to the significance of carbon below. In financialisation “Phase II” ecosystem services then emerged as the “vanguard of the neoliberalisation of nature” (Dempsey and Robertson 2012: 759). For example, in Constanza et al.’s (1997: 255) seminal piece they were valued at \$33 trillion for the Earth, a figure which took ecosystem services as a concept from relative obscurity in ecological economics, to the forefront of the neoliberal counterrevolution to *The Limits to Growth* period (Nelson 2014, 2015). The concept took further momentum from the Millennium Ecosystem Assessment (MEA) project of 2005 supported by the UNEP and Global Environmental Facility; by endorsement by the US EPA in 2009; and in the European “Economics of Ecosystems and Biodiversity” (TEEB) initiative from 2008 to 2010. Current ecosystem service markets are either compliance or voluntary markets and are often commercially divided into the three domains of water, carbon and biodiversity, with recent explorations into a more generic natural capital accounting, which can combine these elements into hybrid

calculations and payment structures. Payments for ecosystem services (PES) schemes numbered over 550 globally in 2018, representing an estimated US\$36-42 billion in annual transactions but remain difficult to grow (Salzman 2018), not least due to problems in the calculability of value.

Financialisation “Phase III” draws in capital markets proper into environment, conservation and climate management. Environment “theme” bonds emerged as a new fixed income asset class from the 2000s, with the City of San Francisco issuing a solar bond in 2001, and the European Investment Bank and World Bank following with climate awareness bonds and green bonds in 2007 and 2008 respectively. The “green” of the title signals de-carbonisation efforts to issuers, institutional investors and governments in either carbon mitigation or adaptation (Kidney et al. 2010: 219). Environmental theme bonds are designed to attract institutional capital by shifting the risk calculation from the projects or activities to be invested in, to the risk profile of the issuer, thus arguably reducing investment risk artificially and generating lower cost financing for the projects invested in (Christophers 2016: 15). Market makers note that theme bonds operate like conventional debt instruments, with similar calculations of risk and credit rating. However, by using “structured note technology” dividends to investors can be actioned against a wide variety of contracted outcomes, such as the performance of an index of “green companies” or a calculation of achieved emissions reductions (Kidney et al. 2010: 220; Mathews and Kidney 2010). Whereas ecosystem services were largely payments made to custodians against quality control criteria, dividends here are financialised in respect of pollution-abatement performances. Critically though, it is only the financial returns of the bond that are legally justiciable. While growing, environmental theme bonds remain an extremely small proportion of equity market volumes overall, representing less than 1% of holdings by global institutional investors, a mere drop in the US\$100 trillion pool under management by institutional investors and sovereign wealth funds (International Monetary Fund 2016: 6). The growth of green bonds in Africa is compromised because they are essentially a debt instrument and credit ratings are poor in most cases. In order to be viable, the green bond must thus be either highly profitable, or enjoy some form of public subsidy, protection or liability insurance. However, these numbers still represent large financial resources as compared to other types of public climate finance in Africa (Bracking 2015: 10; Christophers 2016: 14).

Financialisation “Phase IV” are interest bearing assets framed in more abstract products which refer to nature, humans and non-humans as their referent object, modelled in an aggregated or systemic sense. These would include catastrophe and weather bonds, insurance-linked securities denominated in weather systems, index insurance, multi-peril insurance, and some composite green bonds which are denominated in resilience. Interesting

here is that the unit on which a derivative income stream is raised is not a bounded asset or thing, but a complex system, ecology, environment or modelled concept, such as vulnerability or resilience. As Johnson (2014: 157) summarised, “[as] the provision of catastrophe insurance has been securitized ... place-bound vulnerabilities are rendered into an exploitable, diversifying asset class for financial capital”, and since her seminal analysis of catastrophe bonds a further range of products encompassing total systems have emerged. Catastrophe bonds are a sub-category of the wider asset class called insurance-linked securities (ILS), and represent a convergence of the reinsurance and capital markets begun in the mid-1990s (Culp 2002; World Economic Forum 2008), totalling \$40 billion in bonds issued between 1997 and 2011 (Johnson 2014: 157). Within the public domain, the establishment of the InsuResilience Global Partnership for Climate and Disaster Risk Finance and Insurance Solutions at the UN Climate Conference COP23 in Bonn 2017, and its subsequent issuance of a global index insurance facility (GIIF), an umbrella for over 1.5 million insurance contracts, and mobilisation of its InsuResilience Solutions Fund (ISF), represent the current cutting edge of valuation and product development in applying risk and insurance to the governance of climate change, weather and disaster risk (InsuResilience Global Partnership 2018).

Insurance-linked securities, denominated in risk, seem ideally placed to correlate the other earlier product iterations in the overall dispositif of financialised nature and its governance, since carbon, natural capital and multivariate social and ecological outcomes-based accounting systems can all be made commensurate by risk and its modelled pay-out algorithms which form the financial data of a marketed product. This outcome would facilitate further governance by finance in that risk is a designation calculated within banks and approved by ratings agencies within a modelled set of financial variables and legal rights of different tiers or tranches of shareholders. Since few Phase I-III climate financed products are currently traded in secondary markets, excepting some CERs certificates, risk can act as an effective calibrator, or mediator of the rates of profit extracted when they are combined in portfolios. Thus, in financialised climate finance, value theory could usefully reject its insistence on ideas of fictive commodities and speculation in favour of understanding that the financial products call variously on different calculative variables in order to calibrate their value. These calculative variables and devices are nonetheless combined to generate legally guaranteed income streams in the present, with risk acting as an organising denominator or signifier (rather than risk being a source of value *per se*, as Christophers [2016] has argued).

The historiography above suggests that risk-denominated products are playing an increasing role in climate finance as the dispositif unfolds in reciprocal relation to financialisation as a global process. In the next section, some representative hybrids from the

current financialised landscape of climate finance will be presented to test, analyse and interpret this hypothesis.

The Climate Finance Dispositif

The phases of financialisation outlined above have produced a contemporary climate finance landscape of complex entanglements; differing types of institutional nodes or sites, and different climate finance products. Dispositif is a useful concept to mobilise in understanding contemporary climate finance as it embraces this emergence, complexity and fluidity. Also, unlike its close relative the “assemblage”, a dispositif is generally used to denote an arrangement that is slightly more settled, temporarily at least, in so far as it can apply power over subjects (Agamben 2009). Thus Foucault (1980: 194) used dispositif to apply to:

a thoroughly heterogeneous set consisting of discourses, institutions, architectural forms, regulatory decisions, laws, administrative measures, scientific statements, philosophical, moral, and philanthropic propositions ... [and] the network that can be established between these elements.

Although Foucault’s concern was with diverse forms and means of government *per se*, climate finance is a mobilisation of resources intended to contribute to governing climate change and looks remarkably similar: it is an emergent set of loose things and practices joined by governing nodes in a system of correlation, with certain financial forms splitting, morphing or folding together. Indeed, Braun (2014a: 51) recently and persuasively mobilised this term to describe how a loose, ad hoc government of this type, without an overarching sovereign but only a system of correlation, can characterise urban governance in the context of the “crisis” of climate change.

The concept of an assemblage could also be used to interpret how climate finance attempts to order people, things, nature and more-than-human species, understood as an arrangement of things “which are simultaneously human and nonhuman, social and technical, textual and material – from which action springs” (MacKenzie et al. 2007: 14-15). An assemblage implies a capacity to act through the coming together of things, where this coming together of things is “a necessary and prior condition for any action to occur” (Braun 2008: 671; Dewsbury 2011; Fredriksen and Sullivan 2015: 11-13). The closely related concept of a dispositif, sometimes viewed as a sub-group or type of assemblage, is preferred here though, as climate finance involves relationships of power between holders and entrained subjects, and power provides the basis of relationships of governance, the vital element of Foucault’s approach. The UNFCCC or the Green Climate Fund, which have sufficient legitimacy to authorise the application of power over subjects (see Fredriksen 2015:

18; see also Legg 2011) can be understood as governance nodes within the climate finance dispositif.

In climate finance, none of the chronological phases of product and governance development entirely ended with the beginning of the next, such that the overall structure of climate finance takes on the form of a complex, entangled dispositif linking nodal sites which emerged from within each regime: the UNFCCC and the Clean Development Mechanism from Phase I; regulators, governments and INGOs validators (Phase II); development and green banks, international financial institutions (IFIs), companies and capital markets (Phase III); and more latterly insurance and reinsurance providers, the global Green Climate Fund, GIFF, and Africa Risk Capacity (Phase IV). These institutional governance nodes now correlate to generate hybrid products, both at the level of joint or multiple issuing and underwriting, and by bringing their separate valuation and governance technologies together in complex programmes and products. Most actual products reflect this coming together by incorporating and layering different types of calculative device: carbon accounting, greenness, socio-economic or wellbeing indicators, ecosystem service, and more latterly risk and insurance-based measures.

To understand better the elements of the current dispositif of climate finance a time slice sample of climate finance projects approved in the private green bond market and publically-underwritten GCF in 2016 was analysed. This was not an exhaustive search of all climate related products, as this would be too onerous for the purposes of this paper, but more the selection of a sample to represent the trends of governance and product organisation whose size was chosen to correspond to saturation in the patterns observed, akin to sample size rules in qualitative research. The overall objective was not to establish size or scope in each market, but to explore the “comings together” of calculative systems from the phases of climate finance, as outlined above. Thus, the research for this section consisted of document analysis of the total population of 35 Green Climate Fund projects approved to November 2016 and a desk study of the universe of green bonds approved during 2016 in global markets. Within this overall population, projects combining several calculative techniques to establish value and price are the norm. The examples discussed below are representative of the population, in that they combine different valuation units of account, techniques and calculative devices to produce aggregated financial valuations. However, they are also chosen for further discussion, because they do this in thick nodes, and in innovative or hybrid ways.

Green Climate Fund

The Green Climate Fund was established in 2010 under the United Nations Framework Convention on Climate Change (UNFCCC) as its principal vehicle for providing climate finance at scale, planned to reach US\$100 billion in financing by 2020. As of August 2018, it

had 74 projects representing US\$3.5 billion in committed financing. It has proved a repository for combinations of calculative techniques from all the prior phases of climate finance, not least because many of its early projects were recycled iterations of prior projects sponsored by development finance institutions. Also, the calculative challenges of payment by results from the REDD+ schemes (dated from 2008) were brought to the GCF in 2015-16 for refinancing requests. All GCF projects have also inherited a demand, embedded in the application pro forma, to explain their worth in carbon metrics and in “green-ness” expressed in socio and ecological criteria. Thus, in the Green Climate Fund project approval documentation, two basic indicators of value are used to represent two generic results areas: “reduced vulnerability or increased resilience” for adaptation projects and/or “avoided emissions in tonnes of carbon equivalent” for mitigation and mixed projects. In the carbon emissions avoided metric, applicants often include a cost calculation to the GCF for each tonne, mostly calculated using the UNFCCC CDM system tool for carbon accounting (another borrowed technology from the wider dispositif). As of August 2018, the 74 GCF projects were calculated to benefit 217 million beneficiaries who would emerge with “increased resilience”, while 1.3 billion tonnes of CO₂ equivalent would be “avoided” (GCF 2018), at various calculated costs per tonne per project. This had increased impressively from its February 2017 figures of 103 million beneficiaries, and 183 million tonnes of emissions avoided from only 35 projects (GCF 2016a). By February 2017, the GCF had committed 52 per cent of its finances to the private sector, 72 per cent through its “international access modality” and 47 per cent as grants (GCF 2016a: 6). It is this cohort of projects to the year end of 2016 that is the dataset here.

The international access mode has allowed traditional development finance institutions to redesign their portfolios to access climate finance, by invoking the poor and needy within the new operational concept of resilience at a time when generic development finance is constrained. For example, the UNDP appears to be refinancing much of its work using its international implementing entity status at the GCF by successfully transferring pre-existing development projects into the climate finance domain. The GCF awarded the UNDP US\$38 million to increase the resilience of approximately 2 million people (only 770,500 directly) in Sri Lanka where the beneficiaries are “highly vulnerable, poor, conflict-affected smallholder farmers in the Dry Zone of the country” (GCF 2016b: 6). The “adaptation interventions” consist of installing or improving irrigation systems, decentralised water supply, early warning systems, and upstream watershed restoration totalling \$29.5 million, leaving \$8.5 million for planning and knowledge capacity building (GCF 2016b: 7). The UNDP also achieved a \$29.5 million grant in respect to resilience in Vietnam, claiming to reach 30 million beneficiaries, with 1.9 million equivalent tonnes of CO₂ avoided (GCF 2016c). Meanwhile, and also in the international access modality, the World Bank is the

implementing entity for a project worth just under \$69 million in the Aral Sea Basin for on lending through a regional climate investment facility, which represents a “scaling up” of its former project in the area, the Climate Adaptation and Mitigation Program for Aral Sea Basin (CAMP4ASB). The facility will fund “the poorest and most climate vulnerable rural communities” with \$15 million to be spent on goods and public works and the remaining \$4 million on various consulting services (GCF 2016d: 10).

These projects and similar ones awarded to international development banksⁱⁱ show a tendency to calculate those beneficially affected by using population counts in the territory of intervention as a proxy, while depicting them as suffering multiple deprivations. These counts then signify the socio-economic worth of the project. However, the banks also spend relatively large proportions of funds on planning and management, and their own cost recovery and indirect capacity building. For example, in the Aral Sea Basin, the World Bank calculates its own fees on a “full cost recovery” basis under the per cent “cap” allowed for by the GCF, at US\$510,000 (GCF 2016e: 11). Meanwhile, a US\$41 million grant approved by the GCF for the UNDP in October 2016 to support the implementation of the UNDP led REDD+ approved “Action Plan” in Ecuador is particularly policy focussed (GCF 2016e). This project begins by admitting that the full financialisation envisaged for results-based payments (RBPs) for forest conservation in Ecuador became stalled at the UNFCCC over issues of “price, volumes of emissions reduction, availability of RBP funds, [and] conditions of access” (GCF 2016e: 56), such that RBPs have a “still-uncertain future” (GCF 2016: 15). However, it then commits over US\$9.2 million for “incentives for the sustainable production transition period’, which is presumably for affected persons, while the rest (approximately US\$31.8 million) appears to be solely for management and planning, or the “Priming [of] Financial and Land-Use Planning Instruments” in the project’s title, supporting the work of the UNDP as accredited entity, and the Ministry of Environment as national accredited authority (GCF 2016e). Despite its emphasis on planning, the project still claims to be “worth” 15 million “anticipated tonnes of CO₂ equivalent avoided” in carbon sequestration and of benefit to over 1.1 million people in the “intervention area” (GCF 2016f).

This institution building is significant in Ecuador but has global implications for both climate finance directly and the dispositif emerging. Here GCF funding is said to “maintain the momentum of REDD+” in Ecuador “until [global] conditions for RBPs are in place”, by funding the accreditation of the National Entity in charge of the financial mechanism, the National Forest Monitoring System (NFMS) and safeguard information system (SIS), all prerequisites for qualification for RBPs under the Warsaw Framework (GCF 2016e: 43-44). The support for Ecuador will then “build confidence” in the emerging climate finance architecture, the UNFCCC system of RBPs, and the GCF’s performance management framework (PMF) “channelled through the UNFCCC process” (GCF 2016e: 48, 63). In turn,

the UNDP is positioning itself as “assisting” the GCF in implementing its “Initial Logic Model and PMF for REDD and RBPs”, and “confidence building” where RBPs have not yet materialised (GCF 2016e: 63, 48). It also claims to contribute to the GCF’s policy on results-based payments and milestones-based financing (Green Climate Fund 2016). Thus, a traditional development finance institution (DFI) is partnering with a new node, the GCF, to promote a hybrid financialised product (in that REDD+ entails debt financing and interest-bearing returns) which largely supports institution building to facilitate RBPs reminiscent of the ecological services approach, while also calculating for carbon and “resilience” (a proxy for human development). This project qualifies as a Phase IV product (see above) because a donor or private sector firm is the planned purchaser of the derivative income streams from the unit of preserved, pacified forest, supplied by the domestic government as interest on the REDD+ loan, which is a fully financialised relationship. But of interest to this analysis is that it also includes calculations of worth, value and price from all the preceding phases – while problems of pricing have prevented the full financialisation envisaged.

Challenges to the full financialisation of REDD+ internationally also prompted a hybrid product in October 2016 from another DFI – the International Finance Corporation (IFC) – this time partnering with the private sector in the green bond market, illustrating again a hybrid of Phases I (carbon accounting), II (ecosystem service accounting), III (greenness accounting in bond issuance), and IV (carbon offset units available for trading). Here the IFC listed a US\$152 million “first-of-its-kind” forestry bond on the London Stock Exchange. Uniquely to date, the IFC bond allows investors to be paid in cash or carbon credits, with the latter generated from the Kasigau Corridor project in East Kenya, or a combination of the two, where the bond has a five-year maturity and a coupon of 1.546% interest paid. The Kasigau Corridor is one of the largest REDD+ projects globally, expected to offset 1.4 million tonnes of carbon emissions annually for 30 years, with carbon credits priced at US\$5 per credit. Coupons paid in credits can either be retired to offset the purchasers’ emissions or sold on the offset market. However, significantly the IFC is underwriting the issue, assisted by Bank of America Merrill Lynch, BNP Paribas and JP Morgan as placement agents, and is the guaranteed purchaser of the carbon credits from Kasigau, before distributing them to investors when due. Also, BHP Billiton is providing a “liquidity support mechanism, which will see it buy credits from IFC should investors opt to be paid in cash” (Environmental Finance 2016a). Investors will opt for cash when the carbon credits are passed on by the IFC at a price lower than the bond’s guaranteed 1.546% cash return. In other words, BHP Billiton, arguably a major polluter, is guaranteed a low ceiling price on Kasigau carbon credits – less than 1.546%.

In the Kasigau forest bond, which is a precursor for others where REDD+ projects will be aggregated to provide scale, the IFC is effectively acting as an underwriter to the first

tranche investors who already have a guaranteed 1.546% return on their income for five years, and potentially have a higher income from the carbon credits. In fact, the benefits to investors and banks are clear. Investors have an opportunity to buy carbon offsets in the future, a spot position in relation to carbon, which, if the market recovers during the term, may pay more than the IFC-guaranteed US\$5 per credit, and a swap between the two positions – cash and CERs. The banks involved will have collected management service fees and may also own some first tranche shares themselves or enjoy placement fees from the investors. Investors are thus linked to a nature based financialised commodity (carbon offset unit) and a cash return with arguably very little risk due to the IFC underwriting role: a forest bond from IFC could not be allowed to fail as it may affect its AAA rating.

The Kasigau Bond illustrates the possibility of a green bond with multiple underlying REDD+ assets, where the oversight function for REDD+ assets has moved from the UNFCCC (or the UNDP as in Ecuador above) to the private sector, but a bond in which “public sector” nodes such as the GCF could still invest. This would move the calculation of the product’s worth from a principle denomination in carbon (in its underlying REDD+ assets), to one of commercial green-ness at the level of the bond as a whole. This appears to be a more abstract and nebulous valuation, except that the underlying assets are the same, and the income streams remain the interest repayments. The GCF would then be acting as one node of the overall dispositif in correlation to the UNFCCC acting as the core governance node, the private sector as bond manager, with other thick nodes in implementing agencies, such as UNDP. Indeed, the links between REDD+, the GCF and green bonds are already correlated together in documents at the UNFCCC, particularly following the Warsaw Agreement (UNFCCC 2013) and the COP21 Paris Agreement (UNFCCC 2015) such that the search for product commensurability has begun to create these aggregated “canopy” products. Canopy products could contain various forms of climate finance component products, including green bonds, PES schemes, REDD+ projects or groups of CERs.

The Green Climate Fund, Post-Paris Agreement 2015

The Paris Agreement of 2015 marked a watershed in organisational terms to potentially reinvigorate the climate finance market, although the subsequent actual disbursements of the Green Climate Fund have proved disappointing. However, it did serve to galvanise new efforts in valuation technologies. Financiers employed to invest in climate finance have found in the Paris Agreement principally three concepts with potential as calculative entities for establishing commensurability between products, to facilitate commercialisation and public underwriting of the climate finance market. These contenders for the role of common denominators, or at least organising rationalities, are the (Intended) Nationally Determined Contributions (INDCs or just NDCs) which can be expressed as a group of different projects;

the Nationally Appropriate Mitigation Actions (NAMAs) which group projects in an implementation mechanism; and the internationally transferred mitigation outcomes (ITMOs) which are the most likely unit to facilitate financialisation as they are notional and fluid. Each of these can in turn be made commensurate using a carbon accounting device at a secondary level of calculation, although this is not a necessary step if mitigation outcomes become directly tradable, such as in green bonds that have collected different ecosystem, adaptation and mitigation services together and then registered themselves as a financialised ITMO unit. The tradability of ITMOs may seem a long way off, but text in the Paris Agreement, Article 6, certainly suggests that the commensurability of these units was imagined by participants to potentially link various carbon denominated markets. A “mechanism” and “body” is promised to regulate and authorise such trade (UNFCCC 2015: 5).ⁱⁱⁱ Also, DFIs are developing measurement standards for calculations of emission reductions avoided and rules for measurement, verification and reporting (MRV) for NAMAs, such as the UNDP in its *NAMA Financial Requirements and Mechanisms* guide. An international accounting standard for ITMOs would cement this possibility. But in the meantime, INDCs have already become a “significant” ratings driver, according to Moody’s, who have incorporated the materiality of the COP21 agreement into their credit ratings: as climate affects asset values across sectors, the intentions of INDCs affect corporate and sovereign credit ratings (Moody’s 2016).

The private sector is a powerful advocate of developing these financial and calculative systems which would add to our product specific valuations of carbon emissions avoided, “green” and “resilience” and further facilitate aggregation of climate finance products emerging from the dispositif. For example, Junji Hatano, a Tokyo-based chairman of consultancy Carbon Partners Asiatica, wrote in 2016 that green bonds could accelerate implementation of the Paris Agreement, by financing NAMAs (Environmental Finance 2016b). According to Hatano, NDCs are seen in the Warsaw Agreement as “high-level policy directions”, while NAMAs are the “ideal implementation mechanism for NDCs”^{iv} welcomed as the “missing link” to green bonds (Hatano, cited by Environmental Finance 2016b 2, citing UNFCCC 2013). He writes of two models for this missing link. First, green bonds providing funds to institutions that on-lend for NAMAs (largely an extension of current practice). Second, direct linkage between green bonds and NAMAs in a “NAMA covered green bond” (Environmental Finance 2016b: 2). Because of the expected poor credit rating of the issuer – maybe a southern municipality – investors would need “protection”, which this banker proposes in the collateralisation of cashflows, or by guarantee or country risk insurance provided by a public entity, and/or by much higher interest rate levels charged to the underlying portfolio companies (who take on debt) than those paid out in investor coupons (Environmental Finance 2016b).

However, given this spread, this fund model may perversely restrict the growth of green enterprises in the Global South because they are the main source of collateral that underwrites the risk, and will thus need to be extremely profitable to attract international funding. Potentially they risk their returns disappearing to the international investors, whose income may be guaranteed by the international public sector in any case, although this guarantee will only trigger when some successful companies in the portfolio can't be squeezed enough to cover the losses of others. Financiers invariably seek regulatory support to guarantee returns, such as tax relief, return enhancement, refinancing support, underwriting or government guarantee (Kidney et al. 2010: 231), and these new complex products are no exception, as they invariably involve multi-layered tranche-specific investor guarantees, created to ensure extremely low risk, with high guaranteed returns for privileged investors paid for by public subsidy and a high extraction from underlying companies. Thus, when the calculative concepts of the Paris Agreement are combined with the valuation norms of the preceding phases of climate finance, returns to investors emerge salient, with risk conditioning the distribution of reward among agents.

Calculation in Environmental and Climate Finance

Thus far the examples above have combined calculations of carbon and green-ness and are embedded in the public regulatory system through the GCF, REDD+ or potentially by the institutional regulators promised by the Paris Agreement 2015. Carbon accounting remains the most advanced form of environmental calculation to date, with established standards and forms that NAMAs, ecosystem services, green bonds and insurance products do not have. For example, in a landmark case in America the Chicago-based 7th Circuit US Court of Appeals in a unanimous decision on 8 August 2016, rejected an industry-backed lawsuit that argued that carbon accounting was “irredeemably flawed”. The case had been filed by refrigeration manufacturers petitioning against an energy efficiency ruling of the Department of Energy denominated in carbon emissions (US Court of Appeals 2016: 40).^v The court ruled instead that calculating the social price of carbon “was neither arbitrary nor capricious” (US Court of Appeals 2016: 5). Carbon offsets have also acted as tradable securities, with recognised, but several, accounting and valuation methods, while the G20, whose members contribute 85% of global emissions, are working on regulation to provide “consistent, comparable, reliable and clear disclosure around the carbon intensity of different assets” (Carney 2015: 12). However, denominations in carbon have met many obstacles *in situ* as molecular calculations struggle to quantify complex ecosystem change, and the extensive work required by natural scientists, mathematicians, accountants, auditors and so forth to attest to the carbon properties of complex human and ecology interactions has proved costly, as well as intellectually challenging.

From Phase II onward, new technologies emerged in the dispositif governing climate change which initially promised to be less costly than carbon accounting, and among these were “green-ness”, abstractions of “ecosystem services”, or measured units of “natural capital”. Green bond issuers have made substantial innovations in codes to prove their greenness, although they also benefit from it being hard to prove claims untrue, and there being no legal channel to establish the worth of either claim (Bracking 2015). Just like carbon accounting, greenness emerges from a beyond-human world of complex, animate and distributed agency.

Arguably, a simpler abstraction or convention is needed to mobilise finance, and with unfolding climate change already affecting business, the private sector – in the particular person of insurers – has not waited for public endorsement of green measurement. Indeed, events appear to be bypassing such an outcome, with moves to provide insurance-based products over-taking long public debates over climate economization processes which sought to fix the carbon, ecosystem, or green-ness unit into the valuation of climate finance. Instead, the newer complex modelling systems combine in the insurance industry with algorithmic programmes and emerge in new calculations of risk and its (costed and actionable in the present) eco-calculative siblings, resilience, adaptation and mitigation. These can financialise nature at a further abstract scale to provide a commensurate super-structure to ecocybernetics and the new biopolitics of human management (Braun 2015).

Work on catastrophe bonds and weather insurance has already noted that insurance regimes are happy to proxy for a clear measurement of weather-induced loss and damage reported by actual insured persons by using matrix triggers and weather models, knowledge products owned by corporates close to or connected to the weather securities issuer (Bracking 2016: 99-107; Johnson 2014). In effect, information about the weather serves as a proxy for the effects and patterns of the weather itself, and information about weather or nature more generally is commodified (Loftus and March 2015: 174; Pollard et al. 2008). With this breakthrough in defining the risk regime, climate change can be managed by owners of finance, albeit that in terms of Africa these “service providers” such as the nodal Africa Risk Capacity of the IFC and African Development Bank, established in 2014 at the New York Climate Summit, still seek multilateral underwriting, subsidy and project risk management.

In this move toward insurance-based finance the Paris Agreement text on loss and damage, Article 8, Section 4, flagged future areas of cooperation on loss and damage as “Comprehensive risk assessment and management; (f) Risk insurance facilities, climate risk pooling and other insurance solutions... [alongside] (h) Resilience of communities” (UNFCCC 2015: 8). This signposting occurred in the context of a Treaty text which effectively removed the right to sovereign risk liability based in historic emissions (see Weisser and Müller-Mahn 2017: 811). Thus in an already hyper-indebted Africa,

governments and municipalities will be encouraged to buy insurance-denominated debt instruments, or issue their own securities to investors, covering weather, natural disasters, catastrophes and other multiple risks, and pay a monthly interest premium to the bond holder, with the promise of a pay-out if an event registers as worthy in the trigger matrix owned by the insurer. This represents a highly abstracted panopticon system for the financialisation of climate, which bypasses carbon, green, natural capital or NAMA/ITMO accounting, in favour of a proven system of calculation in which capital owners have at least 400 years of accumulated experience: commercialised risk. The major insurers and banks are rushing to develop multiple risk indexes, such as Lloyd's "Cities at Risk", in the context of a tripling of the number of registered weather-related loss events since the 1980s (Carney 2015: 3).

For example, the "innovative" Kenya National Agricultural Insurance Programme, which follows similar schemes in Mexico, India and China, was launched in March 2016 to insure pastoralists and farmers against droughts and floods, and is underwritten by the World Bank and a flotilla of other bilateral development finance institutions, including the Global Index Insurance Facility (GIIF), a multi-donor trust fund managed by the World Bank Group with funding from the European Union, Japan and The Netherlands. The purpose is to assist farmers' financial resilience to shocks (World Bank 2016). As with all abstract modelling systems, advocates stress the complex science of the "state-of-the-art method of collecting crop yield data, using statistical sampling methods, GPS-tracking devices, and mobile phones" (World Bank 2016). This programme may be the first in Africa, but it is a bridge to a global climate and catastrophe market worth \$123 billion in economic losses by all events and regions in 2015, a figure 30% below the 2000-2014 mean of \$175 billion, of which \$35 billion were insured losses (Aon Benfield 2016: 2-3). Risk and insurance represent a growing means of governance of the poor in relation to climate change that has benefits over the traditional, and declining, mode of development finance. It is cheaper, remote, performative and flexible.

Risk, Time, and Calculation

Risk is playing an increasing role in the climate finance dispositif, evidenced in the expanding scale of the climate insurance market, and the spread of its valuation technologies across into other products. This growth is also a response to climate change itself, as increases in extreme weather encourage people to see the future as more risk-laden, and to experience time itself differently. "New" time is coming toward us from the deep future laden with catastrophe "in the sense of the revelation of things that are coming toward us" (Latour 2013: 12), rather than flowing from the present to the future as it did in modernism (Braun 2015: 239). In this, "the shape of things to come is increasingly seen to be non-analogous with what existed in the past" (Braun 2015: 239) in a "time as Kairos", eventful, non-linear,

with tipping points and ruptures rather than time as *chronos*, repetitive clock time (Negri 2005: 152). Here the speculative mode of risk, with its emphasis on the actionability in the present of an uncertain future, makes insurance a synergistic governance technique in relation to climate change, particularly in respect of non-linear ruptures.

This salience of risk and increase in claims events, in turn, allows owners of finance an increased role in managing climate change through greater investments in climate denominated insurance linked securities. Financiers, by their nature, seek to capitalise on the future, and fix that future in place (Ouma 2015), such that finance has a future orientation, a distended temporality and an inherent stochasticity (Poovey 2015). The “coming together” of financialised climate within conceptions of “new time” opens investment possibilities and adds a new strengthened synergy to risk and finance as climate governance technologies. However, disruptive time has also prompted innovations in risk management, wherein risk calculations in climate finance are increasingly de-linked from an actual reference to specific events, production, or exchange, and made to reside in abstract multi-variate modelling. This once-removed approach to climate governance found in current Phase IV products generates distance between people and their management; and allows climate governance to be performative, giving the appearance if not reality of care. It also denies historical responsibility for emissions and resets the clock at the present, with the poor required to pay for their own adaptation into the uncertain future.

However, these calculations are still not easy. If social and natural science are struggling with new epistemologies made necessary by non-analogous present and future worlds and unpredictable time, as Latour (2013) suggests, the factoring of time into risk frameworks by financial managers of both equity and insurance is facing a similar challenge, not least because the time used by finance traditionally only looks forward to the near horizon. In a seminal speech to this effect, titled “Tragedy of the Horizon”, to Lloyds of London in December 2015, the Governor of the UK Bank of England, Mark Carney, pointed out that most time horizons used by government central banks, the insurance industry, companies and economists are only a few years ahead, such as two to three years for monetary policy, or three to five years for credit ratings, while climate change demands consideration of the time horizon beyond (Carney 2015: 3-4, citing Bank of England 2015). Carney urges insurers to extend their measurement of time and risk further into the future to mitigate climate change effects. This would move the insurance regime, and environmental governance, toward the panopticon of a fully financialised but abstract matrix of nature-based risk.

Conclusion

This paper has argued that the work of calculation to generate climate finance products turns on making commensurabilities between different denominators that link the institutional nodes of the climate finance dispositif, which are still “becoming necessary” (Althusser 2006; Braun 2015; Deleuze and Guattari 1983; Foucault 2007; Marx, 1973). Concepts of carbon, green-ness, resilience and insurance-based accounting, each loosely derived from the phases of a deepening financialisation, come together and correlate in acts of contingent becoming. For example, as we saw above, green bond investors and issuers of insurance securities have reached out to the Green Climate Fund as an institutional node to help manage their emerging hybrid products and aggregated infrastructure and energy assets, with the GCF often facilitating access to public sector guaranteed income streams.

But perhaps ironically when the source of funds is often public, this ability to secure derivative income streams from assets is for many the core of what it means to financialise something (on infrastructure, see Bracking 2016; Hildyard 2016), and is increasingly calculated for climate finance products, particularly as they emerge in Phase IV. This risk calculation then conditions the prices paid for environmental services, insurance or bonds. Thus, while value is discovered in multiple, contested and variously denominated indicators – such as social and ecological impact, resilience, carbon, ecosystem services, or “green-ness” – risk emerges as salient in bringing them together because of its close relationship to income streams. This confers on risk an increasing organisational and denominational role in the dispositif of climate finance.

However, using risk or insurance-based accounting does not solve the calculative challenges within the valuation processes of climate finance. Foundationally, accounting for time and climate change remain challenging academically, scientifically and in business and insurance practice. Time, because traditional financial risk calculations find long temporalities punctuated by crisis events hard to model; and climate change, because the definitive, positivist and biometric natural science calculations for carbon are simply not there, let alone difficult to price, when referent to complex, changing ecological systems (Latour 2014). Much work is required to take flexible nature to financialised product: it needs scenario planning, computer modelling, mediation by banking, finance and insurance (Cooper 2010); it needs to be framed as something capital can “see” (Robertson 2004, 2006); it needs to be conceptualised as services that are pacified and liquid, despite its own animism (Sullivan 2013a, 2013b); and it requires the social articulation of a valuation process in order to arrive pacified at the point of a financial transaction (Bracking et al. 2014).

Throughout this complexity, financiers, just like social and natural scientists, are struggling with accounting for future time and rapid ecological change in the “becoming necessary” of the encounter between nature and finance in the context of climate finance. They are also experiencing experimental failures, like the collapse of the European carbon

market, or the non-implementation of RBPs in REDD+. However, this article has argued that risk is demonstrating the strongest efficacy as an organisational rationality and valuation denominator in the context of contemporary climate finance, while the concept of the *dispositif* has helped to analyse this assemblage as one which gives a greater power to financial calculation, and thus to financiers, in the management of nature-society relations.

Endnotes

Notes

1. Christophers recently argued for a 'risking' of Marxist value theory, wherein risk should be designated as the singular source of financialised value (2016). This article disagrees with assigning risk as the single source of value but does argue that it is a central organising concept for the pricing of financialised products.
2. The World Bank has also been awarded a \$27.3 million project in Mali, the Inter-American Development Bank a \$20 million guarantee and \$2 million grant, while the European Bank for Reconstruction and Development secured a USD344 million loan to join its USD 1 billion investment.
3. Paris Agreement section 4 on ITMOs '(c) To contribute to the reduction of emission levels in the host Party, which will benefit from mitigation activities resulting in emission reductions that can also be used by another Party to fulfil its nationally determined contribution; and (d) To deliver an overall mitigation in global emissions'
4. Warsaw Agreement (UNFCCC, 2013, 4) talks of NDCs as being produced 'without legal prejudice' as perhaps a 'protocol'. NAMAs are referred to (2013, 4, 5, 31) in the context of quantification of emissions, implementation and accurate measurement with respect to forest carbon sequestration.
5. US Court of Appeals (2016, 39) The Department of Energy employed 'an estimate of the monetized damages associated with an incremental increase in carbon emissions in a given year,' known as the Social Cost of Carbon (SCC)
6. Foucault's account of history as contingencies of the possible summarised in his 'historical ontology', is similar to Althusser's account of history as the 'becoming-necessary of contingent encounters' (2006, cited in Braun, 2014b, 7), or Deleuze and Guattari's 'universal history of contingency' (1983, 224).

References

- Agamben G (2009) *What is an Apparatus? And Other Essays* (trans D Kishik and S Pedatella). Stanford: Stanford University Press
- Althusser L (2006) *Philosophy of the Encounter: Later Writings, 1978-1987* (trans G M Goshgarian). London: Verso
- Aon Benfield (2016) "2015 Natural Disaster Events and Loss Trends."
- Bank of England (2015) "Systemic Risk Survey."
<https://www.bankofengland.co.uk/systemic-risk-survey/2015/2015-h1> (last accessed 26 November 2018)
- Bracking S (2015) Performativity in the green economy: Does climate finance create fictive accumulation? *Third World Quarterly* 36(12):2337-2357

- Bracking S (2016) *Financialisation of Power: How Financiers Rule Africa*. New York: Routledge
- Bracking S, Brockington D, Bond P, Büscher B, Igoe J J, Sullivan S and Woodhouse P (2014) "Initial Research Design: 'Human, Non-Human, and Environmental Value Systems: An Impossible Frontier?'" Working Paper 1, Leverhulme Centre for the Study of Value <http://thestudyofvalue.org/wp-content/uploads/2013/11/WP1-Initial-Research-Design-final.pdf> (last accessed 26 November 2018)
- Braun B (2008) Environmental issues: Inventive life. *Progress in Human Geography* 32(5):667-679
- Braun B (2014a) A new urban dispositif? Governing life in an age of climate change. *Environment and Planning D: Society and Space* 32(1):49-64
- Braun B (2014b) New materialisms and neoliberal natures. *Antipode* 47(1):1-14
- Braun B (2015) Futures: Imagining socioecological transformation. *Annals of the Association of American Geographers* 105(2):239-243
- Brockington D and Duffy R (2010) Capitalism and conservation: The production and reproduction of biodiversity conservation. *Antipode* 42(3):469-484
- Büscher B (2013) Nature on the move: The value and circulation of liquid nature and the emergence of fictitious conservation. *New Proposals* 6(1/2):20-36
- Carney M (2015) "Breaking the Tragedy of the Horizon: Climate Change and Financial Stability." Speech by Mark Carney, Governor of the Bank of England, at Lloyd's of London, 29 September <http://www.bankofengland.co.uk/publications/Documents/speeches/2015/speech844.pdf> (last accessed 19 November 2018)
- Castree N (2010) Neoliberalism and the biophysical environment 1: What "neoliberalism" is, and what difference nature makes to it. *Geography Compass* 4(12):1725-1733
- Christophers B (2012) Anaemic geographies of financialisation. *New Political Economy* 17(3):271-291
- Christophers B (2015) The limits to financialization. *Dialogues in Human Geography* 5(2):183-200
- Christophers B (2016) Risking value theory in the political economy of finance and nature. *Progress in Human Geography* DOI:10.1177/0309132516679268
- Costanza R, d'Arge R, de Groot R, Farber S, Grasso M, Hannon B, Limburg K, Naeem S, O'Neill R V, Paruelo J, Raskin R G, Sutton P and van den Belt M (1997) The value of the world's ecosystem services and natural capital. *Nature* 387:253-260
- Cooper M (2010) Turbulent worlds: Financial markets and environmental crisis. *Theory, Culture, and Society* 27(2/3):167-190
- Culp C (2002) *The Art of Risk Management*. New York: John Wiley & Sons

De Goede M and Randalls S (2009) Precaution, pre-emption: Arts and technologies of the actionable future. *Environment and Planning D: Society and Space* 27(5):859-878

Deleuze G and Guattari F (1983) *Anti-Oedipus* (trans R Hurley, S Mark and H R Lane). Minneapolis: University of Minnesota Press

Dempsey J (2017) The financialization of nature conservation? In B Christophers, A Leyshon and G Mann (eds) *Money and Finance After the Crisis* (pp191-216). Oxford: Wiley

Dempsey J and Robertson M (2012) Ecosystem services: Tensions, impurities, and points of engagement within neoliberalism. *Progress in Human Geography* 36(6):758-779

Dewsbury J-D (2011) The Deleuze-Guattarian assemblage: Plastic habits. *Area* 43(2):148-153

Environmental Finance (2016a) IFC upsizes \$152 million forestry bond. 31 October

Environmental Finance (2016b) How green bonds could speed progress towards Paris goals. 28 October

Foucault M (1980) The confession of the flesh. In C Gordon (ed) *Power/Knowledge: Selected Interviews and Other Writings* (pp194-228). New York: Pantheon

Foucault M (2007) *Security, Territory, Population: Lectures at the College De France, 1977-78* (trans G Burchell). Palgrave Macmillan, New York

Fredriksen A (2015) Apparatus/dispositif. In A Fredriksen, S Bracking, E Greco, J Igoe, R Morgan and S Sullivan (eds) "A Conceptual Map for the Study of Value: An Initial Mapping of Concepts for the Project 'Human, Non-Human, and Environmental Value Systems: An Impossible Frontier?'" (pp17-18). Working Paper 2, Leverhulme Centre for the Study of Value <http://thestudyofvalue.org/wp-content/uploads/2013/11/WP2-A-conceptual-map.pdf> (last accessed 26 November 2018)

Fredriksen A and Sullivan S (2015) Agencement/assemblage. In A Fredriksen, S Bracking, E Greco, J Igoe, R Morgan and S Sullivan (eds) "A Conceptual Map for the Study of Value: An Initial Mapping of Concepts for the Project 'Human, Non-Human, and Environmental Value Systems: An Impossible Frontier?'" (pp10-13). Working Paper 2, Leverhulme Centre for the Study of Value <http://thestudyofvalue.org/wp-content/uploads/2013/11/WP2-A-conceptual-map.pdf> (last accessed 26 November 2018)

GCF (2016) "Support for REDD-plus. Meeting of the Board, 12-14 October, Songdo, Incheon, Republic of Korea, Provisional agenda item 8(b), GCF/B.14/03." Green Climate Fund https://www.greenclimate.fund/documents/20182/409835/GCF_B.14_03_-_Support_for_REDD-plus.pdf/665055cb-78bd-45f3-a666-f3d06fb04a15 (last accessed 26 November 2018)

GCF (2016a) "Projects." <http://www.greenclimate.fund/projects/portfolio> (last accessed 19 November 2018)

GCF (2016b) “Consideration of Funding Proposals – Addendum: Funding Proposal Package for FP016. Meeting of the Board, 28-30 June, Songdo, Incheon, Republic of Korea, Provisional agenda item 12(e), GCF/B.13/16/Add.08.” Green Climate Fund

http://www.greenclimate.fund/documents/20182/226888/GCF_B.13_16_Add.08_-_Funding_proposal_package_for_FP016.pdf/e0ef564a-e3fb-459d-bf01-1503a9760a0e (last accessed 26 November 2018)

GCF (2016c) “Consideration of Funding Proposals – Addendum: Funding Proposal Package for FP013. Meeting of the Board, 28-30 June, Songdo, Incheon, Republic of Korea, Provisional agenda item 12(e), GCF/B.13/16/Add.05.”

http://www.greenclimate.fund/documents/20182/226888/GCF_B.13_16_Add.05_-_Funding_proposal_package_for_FP013.pdf/c06ab9c0-5109-4a33-aba4-608973d010ab (last accessed 26 November 2018)

GCF (2016d) “Consideration of Funding Proposals – Addendum: Funding Proposal Package for FP014. Meeting of the Board, 28-30 June, Songdo, Incheon, Republic of Korea, Provisional agenda item 12(e), GCF/B.13/16/Add.06.”

http://www.greenclimate.fund/documents/20182/226888/GCF_B.13_16_Add.06_-_Funding_proposal_package_for_FP014.pdf/e72238c5-d1b7-4055-8304-99824e4aebbc (last accessed 26 November 2018)

GCF (2016e) “Consideration of Funding Proposals – Addendum II: Funding Proposal Package for FP019. Meeting of the Board, 12-14 October, Songdo, Incheon, Republic of Korea, Provisional agenda item 11(f), GCF/B.14/07/Add.02.”

http://www.greenclimate.fund/documents/20182/409835/GCF_B.14_07_Add.02_-_Funding_proposal_package_for_FP019.pdf/891deb19-2417-48d7-982a-da3c93470209 (last accessed 26 November 2018)

GCF (2016f) “Project FP019”

<http://www.greenclimate.fund/-/priming-financial-and-land-use-planning-instruments-to-reduce-emissions-from-deforestation?inheritRedirect=true&redirect=%2Fprojects%2Fbrowse-projects> (last accessed 19 November 2018)

Hildyard N (2016) *Licensed Larceny Infrastructure: Accumulation and the Global South*. Manchester: Manchester University Press

Igoe J (2013) Nature on the move II: Contemplation becomes speculation. *New Proposals* 6(1/2):37-49

InsuResilience Global Partnership (2018) “The Global Index Insurance Facility (GIIF).”

<https://www.insuresilience.org/global-index-insurance-facility-giif/> (last accessed 26 November 2018)

- International Monetary Fund (2016) "From Global Savings Glut to Financing Infrastructure: The Advent of Investment Platforms." Working Paper WP/16/18
<https://www.imf.org/external/pubs/ft/wp/2016/wp1618.pdf> (last accessed 26 November 2018)
- Johnson L (2011) "Insuring Climate Change? Science, Fear, and Value in Reinsurance Markets." Unpublished PhD thesis, University of California, Berkeley
- Johnson L (2014) Geographies of securitized catastrophe risk and the implications of climate change. *Economic Geography* 90(2):155-185
- Kidney S, Veys A, Flensburg C and Jones B (2010) Environmental theme bonds: A new fixed income asset class. In J Mangat (ed) *Sustainable Banking: Risk, Reward, and the Future of Finance*. London: IFR Market Intelligence, Thomson-Reuters
- Krippner G (2004) "What is Financialization?" Unpublished manuscript, University of California, Los Angeles
- Krippner G (2005) The financialization of the American economy. *Socio-Economic Review* 3(2):173-208
- Labban M (2010) Oil in parallax: Scarcity, markets, and the financialization of accumulation. *Geoforum* 41:541-552
- Labban M (2014) Against shareholder value: Accumulation in the oil industry and the biopolitics of labour under finance. *Antipode* 46(2):477-496
- Latour B (2013) Telling friends from foes in the time of the Anthropocene. In C Hamilton, C Bonneuil and F Gemenne (eds) *The Anthropocene and the Global Environmental Crisis: Rethinking Modernity in a New Epoch* (pp145-155). London: Routledge
- Latour B (2014) Agency at the time of the Anthropocene. *New Literary History* 45(1):1-18
- Legg J (2011) Assemblage/apparatus: Using Deleuze and Foucault. *Area* 43(2):128-133
- Loftus A and March H (2015) Financialising nature? *Geoforum* 60:172-175
- MacKenzie D, Muneisa F and Sui L (eds) (2007) *Do Economists Make Markets? On the Performativity of Economics*. Princeton: Princeton University Press
- Marx K (1973 [1857]) *Grundrisse* (trans M Nicolaus). London: Penguin
- Mathews J A and Kidney S (2010) Climate bonds: Mobilizing private financing for carbon management. *Carbon Management* 1(1):9-13
- Mawdsley E (2018) Development geography II: Financialization. *Progress in Human Geography* 42(2):264-274
- Moody's Investors Service (2016) Moody's to use greenhouse gas emission reduction scenario consistent with Paris Agreement to analyze carbon transition risk. 28 June
https://www.moodys.com/research/Moodys-to-use-greenhouse-gas-emission-reduction-scenario-consistent-with--PR_351269 (last accessed 19 November 2018)
- Negri T (2005) *Time for Revolution*. London: Continuum

- Nelson S (2014) Resilience and the neoliberal counterrevolution: From ecologies of control to production of the common. *Resilience* 2(1):1-17
- Nelson S (2015) Beyond *The Limits to Growth*: Ecology and the neoliberal counterrevolution. *Antipode* 47(2):461-480
- O'Malley P (2003) Governable catastrophes: A comment on Bougen. *Economy and Society* 32(2):275-279
- O'Malley P (2004) *Risk, Uncertainty, and Government*. London: Glasshouse
- Ouma S (2015) Getting in between M and M', or, How farmland further debunks financialization. *Dialogues in Human Geography* 5(2):225-228
- Pollard J S, Oldfield J, Randalls S and Thornes J E (2008) Firm finances, weather derivatives, and geography. *Geoforum* 39:616-624
- Poovey M (2015) On the "limits to financialisation". *Dialogues in Human Geography* 5(2):220-224
- Pryke M (2007) Geomoney: An option on frost, going long on clouds. *Geoforum* 38:576-588
- Robertson M (2004) The neoliberalization of ecosystem services: Wetland mitigation banking and problems in environmental governance. *Geoforum* 35(3):361-373
- Robertson M (2006) The nature that capital can see: Science, state, and market in the commodification of ecosystem services. *Environment and Planning D: Society and Space* 24(3):367-387
- Robertson M (2012) Measurement and alienation: Making a world of ecosystem services. *Transactions of the Institute of British Geographers* 37(3):386-401
- Salzman J (2018) The global status and trends of Payments for Ecosystem Services. *Nature Sustainability* 1:136-144
- Stockhammer E (2004) Financialisation and the slowdown of accumulation. *Cambridge Journal of Economics* 28(5):719-741
- Sullivan S (2013a) Banking nature? The spectacular financialisation of environmental conservation. *Antipode* 45(1):198-217
- Sullivan S (2013b) Nature on the move III: (Re)countenancing an animate nature. *New Proposals* 6(1/2):50-71
- UNFCCC (2013) "Report of the Conference of the Parties on its 19th Session, held in Warsaw from 11 to 23 November 2013 – Addendum: Part 2, Action taken by the Conference of the Parties at its 19th Session, FCCC/CP/2013/10/Add.1." UN Framework Convention on Climate Change <http://unfccc.int/resource/docs/2013/cop19/eng/10a01.pdf> (last accessed 26 November 2018)
- UNFCCC (2015) "Paris Agreement." UN Framework Convention on Climate Change https://unfccc.int/files/meetings/paris_nov_2015/application/pdf/paris_agreement_english.pdf (last accessed 26 November 2018)

US Court of Appeals (2016) United States Court of Appeals for the Seventh Circuit 2016, Nos. 14-2147, 14-2159, & 14-2334, Zero Zone, Inc., et al., Petitioners, V. United States Department of Energy, et al., Respondents.” <http://media.ca7.uscourts.gov/cgi-bin/rssExec.pl?Submit=Display&Path=Y2016/D08-08/C:14-2159:J:Ripple:aut:T:fnOp:N:1807496:S:0> (last accessed 26 November 2018)

Weisser F and Müller-Mahn D (2017) No place for the political: Micro-geographies of the Paris Climate Conference 2015. *Antipode* 49(3):802-820

World Bank (2016) “Kenyan Farmers to benefit from innovative insurance program.” Press release, 12 March <http://www.worldbank.org/en/news/press-release/2016/03/12/kenyan-farmers-to-benefit-from-innovative-insurance-program> (last accessed 26 November 2018)

World Bank (2018) “State and Trends of Carbon Pricing 2018.” Report, May <https://openknowledge.worldbank.org/bitstream/handle/10986/29687/9781464812927.pdf>

World Economic Forum (2008) “Convergence of Insurance and Capital Markets.”

ⁱ Christophers (2016) recently argued for a “risking” of Marxist value theory, wherein risk should be designated as the singular source of financialised value. This article disagrees with assigning risk as the single source of value but does argue that it is a central organising concept for the pricing of financialised products.

ⁱⁱ Paris Agreement section 4 on ITMOs: “(c) To contribute to the reduction of emission levels in the host Party, which will benefit from mitigation activities resulting in emission reductions that can also be used by another Party to fulfil its nationally determined contribution; and (d) To deliver an overall mitigation in global emissions”.

ⁱⁱⁱ The Warsaw Agreement (UNFCCC 2013: 4) talks of NDCs as being produced “without legal prejudice” as perhaps a “protocol”. NAMAs are referred to (UNFCCC 2013: 4, 5, 31) in the context of quantification of emissions, implementation and accurate measurement with respect to forest carbon sequestration.

^{iv} US Court of Appeals (2016: 39). The Department of Energy employed “an estimate of the monetized damages associated with an incremental increase in carbon emissions in a given year”, known as the Social Cost of Carbon (SCC).

^v Foucault’s account of history as contingencies of the possible summarised in his “historical ontology”, is similar to Althusser’s account of history as the “becoming-necessary of contingent encounters” (2006, cited in Braun 2014b: 7), or Deleuze and Guattari’s “universal history of contingency” (1983: 224).